
FROM EARTH TO SPACE
&
BACK AGAIN
Earth Applications in Advanced Technology
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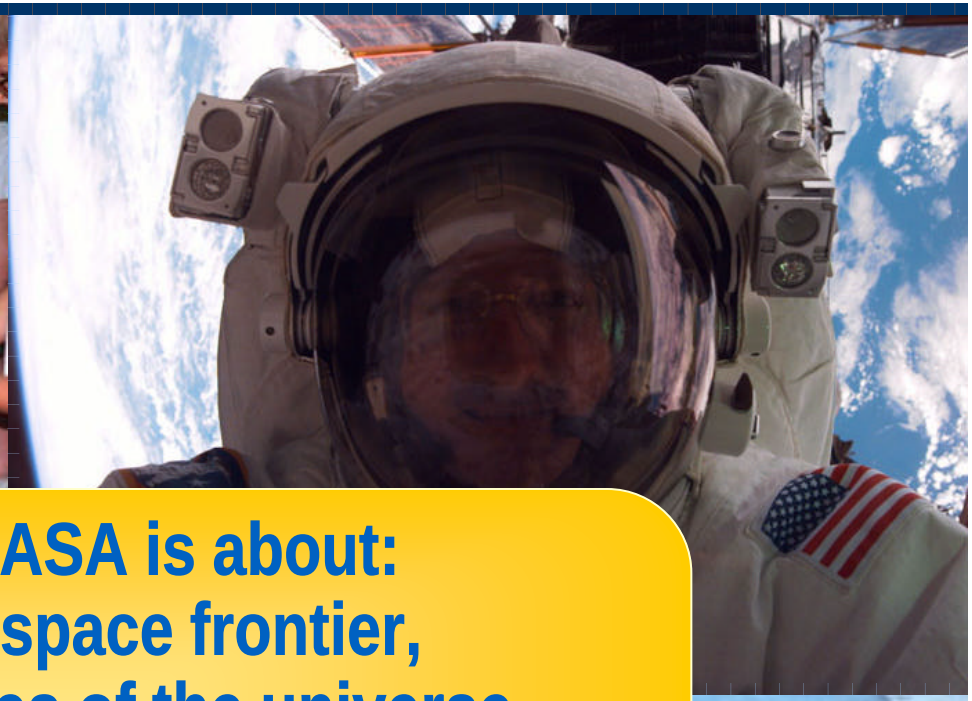
NASA Johnson Space Center
May 24, 200



**“This is what NASA is about:
Opening up the space frontier,
Solving the mysteries of the universe,
And bringing the discoveries into our homes.”**

—Daniel S. Goldin, NASA administrator

Why do NASA's accomplishments in human spaceflight and exploration mean

better lives for everyone on Earth?

low mass | low power | reliable | minimal size

autonomous | non-invasive | regenerable or recyclable

Many of the challenges inherent in designing a spacecraft and environment for astronauts are challenges that industries face every day here on Earth

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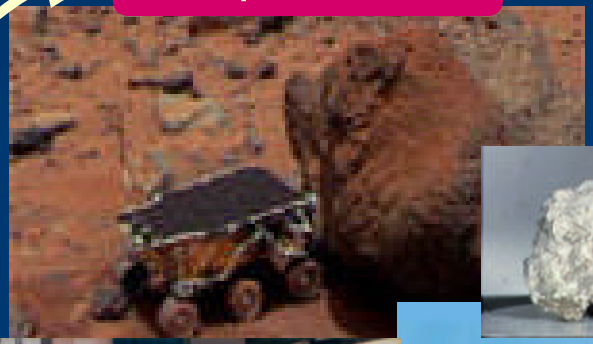
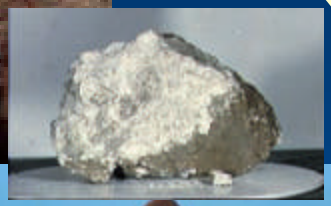
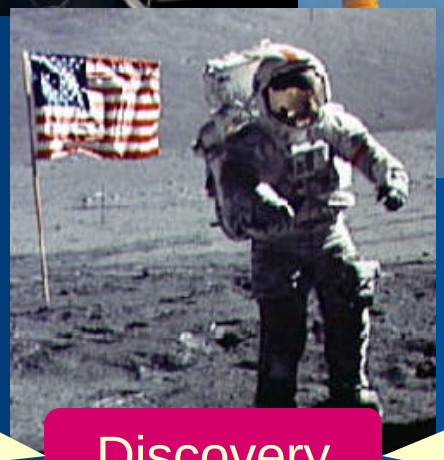
Exploration





Research

Technology Development



Discovery

Technology Transfe
& Commercializatior

Technology spinoffs are "technologies twice used"

The Little Pump That Can

Implantable Heart Pump

Total national annual cost of congestive heart failure is ***$21 Billion***

Cardiovascular disease is the #1 killer of both women and men in the United States

- 40,000 Americans under the age of 65 need a heart transplant
  - Only 2,500 donor hearts available
  - For some patients, transplant may not be indicated
- An implantable heart pump postpones or eliminates the need for a transplant
- The DeBakey heart pump has 50,000 - 60,000 prospective patients annually in the United States (adults and children)

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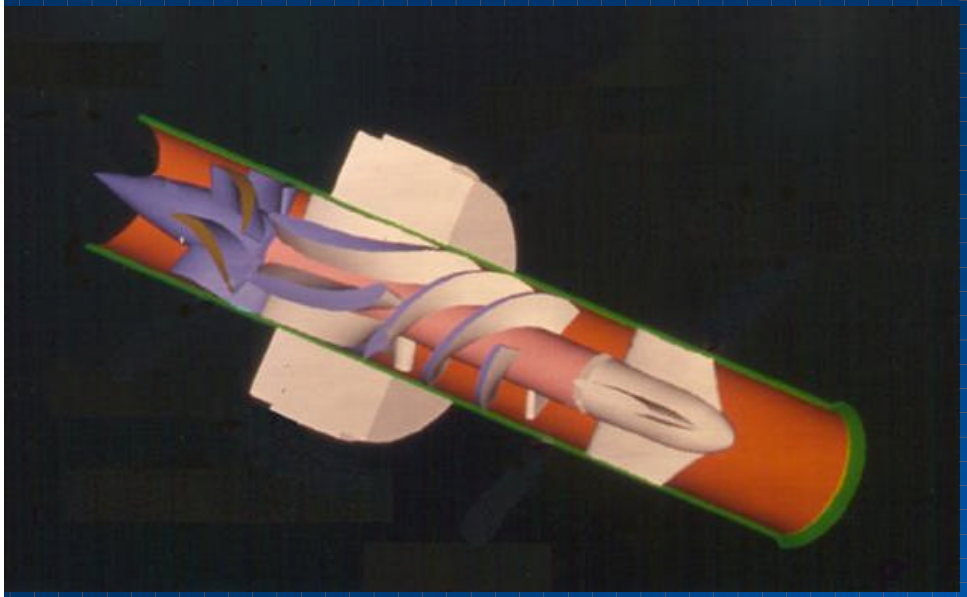
The Little Pump That Can

Implantable Heart Pump



*The **DeBakey heart pump** is a small implantable device with multiple medical uses that can assist thousands of heart and transplant patients*

1937 Dr. DeBakey invents the first pump to model heart function

1989 NASA & Baylor College of Medicine start their collaboration on the development of a heart by-pass pump using NASA technology

1998 A sophisticated, implantable Ventricular Assist Device (VAD™) ha been commercially licensed and is approved for human testing in Europe

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Beyond the Black Bag
Portable Diagnosis Tools

The Telemedicine Instrumentation Pack (TIP) houses a suite of diagnostic instruments

- Designed to allow medical diagnosis in remote or underserved areas
- Incorporates NASA astronaut monitoring, electronic circuitry, and microminiaturization technologies for use on the Space Shuttle and International Space Station
- Related technologies permit diagnosis and treatment of life-threatening conditions
  - Porta-Fib III
  - Portable Medical Status and Treatment System

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Anywhere, Anytime
Portable Blood Pressure Monitor

- Developed to monitor astronaut blood pressure semi-automatically
- Permits highly accurate blood pressure measurement, even by untrained personnel
- Weighs only 6 pounds and can be carried anywhere

- Vital-2 unit is sold commercially to hospitals, medical screening clinics, physicians, and anesthesiologists

Swallow That Thermometer!

Ingestible Thermometer

- Ingestible thermometer is housed in a three-quarter inch capsule containing
  - a telemetry system,
  - a micro battery, and
  - a quartz crystal temperature sensor
- Capsule tracks the core temperature of crewmembers throughout mission activities
- The CorTemp system incorporates several space technologies, including telemetry and microminiaturized circuit, sensor, and battery technologies
- Permits continuous monitoring of airline crews and other personnel in everyday situations

Credit: HTI Technologies, Inc.

The mini-thermometer permits highly accurate measurement of core body temperature

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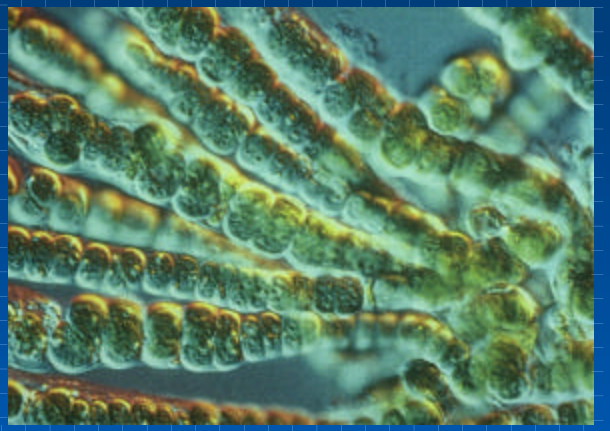
Better for Babies
Enhanced Infant Formula

Formulaid *capitalizes on the nutritional value of algae and supplies developing infants with essential nutrients*



- NASA explored uses of algae as a food supply, an oxygen source, and a recycling agent for long-duration space travel
- Commercially licensed product is an algae-based, vegetable-like oil containing two essential compounds that may serve a role in mental and visual development:
  - DHA (docosahexaenoic acid)
  - ARA (arachidonic acid)
- DHA and ARA are found in human milk, but not in most infant formulas

Got the Flu?
Drug Design

Total national annual cost of influenza-related illnesses is
$20 billion

The high mutation rates of the flu virus have hindered development of new drugs or vaccines

- Space- and Earth-grown crystals have revealed new information about the molecules involved in the spread of the influenza virus from its host cell
- Drugs are being engineered that will retard the spread of the influenza virus in the body
- In collaboration with its corporate partner, the Center for Macromolecular Crystallography has refined drug structure in preparation for clinical trials

2004 Tested and approved relief for the flu is expected to reach drugstores

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No Wires Needed

Wireless Augmented Reality Prototype

The capacity to monitor,access, and communicate large amounts of information has made wireless technologies, like the Wireless Augmented Reality Prototype (WARP), a necessity

- WARP conceived as a means to provide unobtrusive, hands-free access to data and communications for astronauts
- Allows video, audio, and data exchange between base and remote units worn by astronauts
- Currently in Phase II, with final delivery expected in 2002

Medical Applications

- telemedicine/remote consultations
- heads-up vital sign monitoring
- bio-hazard suit operation

Industrial Applications

- tetherless operations consoles
- inspection/inventory
- hands-free maintenance diagrams
- remote site consultations

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Water, Water, Everywhere
Water Purification System

- Water purification systems in the Apollo spacecraft employed a unique silver ionization method

- Subsequent development and commercialization of NASA technology:
  - Kills over 99% of waterborne bacteria and viruses within 5 seconds of contact
  - Eliminates scale, corrosion, algae, bacteria, and debris
  - Does not require an electricity source
- Current uses:

Ice manufacturing plants

Industrial cooling towers

Amusement parks

Swimming pools

Water supply in developing countries or after a natural disaster

Getting Badged
Toxicity Warning Badge

Reliable, disposable badges minimize exposure to toxic vapors

- Monitors exposure of ground personnel to two dangerous gases that are carcinogens and highly flammable
- Tracks when and to what extent exposure has occurred

- Worn by workers in potentially toxic environments to provide warning of exposure to hazardous chemicals
- Used by chemical companies worldwide to detect toxic gas and to sample ambient air

The Air We Breathe
Gas Exposure Sensors

- Originally developed for Gemini and Biosatellite spacecraft systems
- Sensor provides both a visual and audible alarm if the concentration of the gas exceeds preset levels
- Offers substantial improvements in measuring accuracy over earlier warning indicators

- Designed to help users meet safety requirements for industrial atmospheres, as specified by the Occupational Safety and Health Administration and other regulatory agencies

Compact, unobtrusive badge worn by firefighter to monitor carbon monoxide exposure

OSHA

E- Nose Knows

Electronic Nose Sensor

Electronic-nose (e-nose) is a miniature environmental monitoring instrument that detects and identifies a wide range of molecules in a manner similar to the human nose

- The air supply aboard a spacecraft is limited and it must be carefully monitored, filtered, and recycled throughout a mission
- E-nose detects, identifies, and quantifies potentially harmful gases and vapors
- Flown most recently during a 1998 Shuttle mission; e-nose will also be used on the International Space Station

- A commercial version of the e-nose has many applications in environmental monitoring, especially the detection of hazardous fumes in refineries, oil rigs, chemical plants, and security systems

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“We almost take for granted the returns on NASA's past investments:
global communications,
TV satellite broadcasts,
extended weather forecasting,
digital imaging,
fire retardant materials,
smoke detectors,
computer barcoding,
disposable diapers,
the pacemaker,
scratch-resistant glasses,
cordless power tools,
remote monitoring devices for intensive care patients,
and countless contributions to commercial aircraft engines and air traffic systems.”

—Daniel S. Goldin
NASA administrator

Additional Information

If you would like to learn more about NASA's spinoffs or other technologies:

- Visit with NASA engineers and scientists at **Inspection Day 2000**
  - To be held November 1-3, 2000 at Johnson Space Center
  - To learn more and to register online, visit http://inspection.jsc.nasa.gov/
- Visit the Office of Technology Transfer and Commercialization **website** http://technology.jsc.nasa.gov/